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Analysis of renewable energy progress in the western Balkan countries: Bosnia–Herzegovina and Serbia

Charikleia Karakosta*, Maria Flouri, Stamatia Dimopoulou, John Psarras

National Technical University of Athens, School of Electrical and Computer Engineering, Decision Support Systems Laboratory (EPU-NTUA), 9, Iroon Polytechniou str., 15780, Athens, Greece

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ABSTRACT

Within the framework of achieving the European environmental targets towards climate change mitigation, as well as decreasing the fossil fuel dependence and its negative effects on global warming, renewable energy sources (RES) promotion has become a major issue of concern in most European Union (EU) countries. In the above context, most EU countries have endorsed initiatives to foster RES implementation development and inclusion in the energy mix, aiming to endeavor and further impel the benefits deriving from RES and harmonize to the EU Directive or Kyoto Protocol. Nevertheless, only few sporadic efforts have been examining countries and compare the requirements for promoting RES implementation that lack specific RES obligations or a framework set by the Kyoto Protocol or the EU Directive, and particular Balkans countries with great RES potential, such as BiH and Serbia. The main objective of this paper is to analyze the conditions and modalities for RES progress within the economic, political and institutional dimension, in these two neighboring countries located in the vicinity of EU Member States (MS), which appear to have a similar historical, political and economical background and an extensive RES potential. The analysis indicated that RES development in BiH seems to be a slow process, its institutional framework is partly established and further strengthening is required. In Serbia, the institutional framework is efficiently established, are in the process of developing new legislation to facilitate renewable energy development.

Contents

1. Introduction

Concerns about global warming have been continuously increasing over the past years. The European Union (EU) has recognized the need for measures to tackle climate change and has set ambitious targets for the reduction of Greenhouse Gas (GHG) emissions [1]. Additionally, within the framework of EU's continuously increasing energy demand, the deployment of renewable energy sources (RES) is considered a major focal point in achieving the European environmental targets, as well as decreasing the negative effects that consumption patterns appear to have on global warming [2–4].

* Correspoding author. Tel.: +30 210 7722083x2084; fax: +30 210 7723550.
E-mail address: chkara@epu.ntua.gr (C. Karakosta).

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Integrating RES in a country's energy development strategy yields significant benefits, as, renewable energy technologies have a far lower environmental impact than fossil fuels and nuclear power; in this way, they contribute to reduce greenhouse emissions and, consequently, to meet Kyoto targets and slow down global warming [5]. Furthermore, development of RES creates opportunities for national energy supply diversification [6], introducing a stable source of energy in the country's mix, as well as generates a positive impact on local sustainable development and employment [7,4]. Finally, RES development brings economic benefits, as their operational costs are less, while stable prices prevent general market instabilities.

Within the above framework, most countries inside the EU area have endorsed initiatives to foster RES and introduce it in their energy mix. In fact, in 2006 the EU adopted an action plan [8], which aimed at achieving a 20% reduction in consumption of primary energy by 2020. However, levels of RES utilization within the EU territory vary significantly. Contradictory cases, in which even neighboring countries have totally different RES targets, or lack legislatory or institutional framework for the support of RES, appear quite often.

For instance, Denmark is an example of how sustainable development strategies, represented by a combination of conservation, efficiency improvements and RES can be implemented, while being able to convert into a 100% renewable energy system in terms of technology and domestic resources [9–11]. On the other hand, although Greece has introduced measures towards RES promotion and support, such as investment support measures, reduction of taxable income on expenses for domestic appliances or systems using RES, a concrete bidding procedure to ensure rational use of geothermal energy [12], the expected progress has not been achieved, still depending on traditional energy sources such as coal or oil [13]. This is further underlined in the European Commission's working document (2011) [14], where Greece presents no progress in relation to the 2010 targets. Other European countries like Bosnia–Herzegovina (BiH) and Serbia appear to have serious deficits in the RES promotion framework, lacking specific RES obligations and being characterized by a growing energy demand, which is satisfied mostly through fossil fuels, despite the fact that they are aware of RES significance, their beneficial character and the need for their integration, development and implementation.

According to the abovementioned, it becomes clear that in order for countries to endeavor the benefits deriving from RES, such as filling the gap between domestic energy production and consumption and maintaining their economic growth, seems necessary to integrate renewable energy into their sustainable energy strategy. Nevertheless, only sporadic efforts have been implemented for the examination of countries that lack specific RES obligations, set from the Kyoto Protocol or the EU Directive [15]. This is the case for both BiH and Serbia.

Within the above framework, main objective of this paper is to examine and compare the RES progress in these two neighboring countries, located in the vicinity of EU Member States (MS), namely BiH and Serbia, which appear to have a similar historical, political and economical background and an extensive RES potential. Main characteristic of both these countries, part of the Western Balkans, is that although they have a high potential for developing energy production from renewable energy sources (RES) this potential is not studied and exploited enough, while the present situation for their utilization is not considered good [16]. In particular, both countries were examined in terms of their macroeconomic situation, the status of the energy sector, the RES institutional and regulatory framework, as well as the current RES progress and potential. The adopted approach is based on coherent methodological steps so as to enable an integrated study and a comparative analysis of RES progress in BiH and Serbia.

Apart from the introduction this paper is structured along three sections. Section 2 presents and analyses the main characteristics of the four steps followed in the adopted approach. Section 3 provides the comparative analysis of BiH and Serbia though the description of their energy profile, the RES institutional and political framework and their RES potential. Finally, Section 4 summarizes the main results drawn up from this paper.

2. Approach followed

The approach adopted for the investigation of the RES progress in BiH and Serbia is constituted by a four step comparative analysis and is described below.

Step 1: Country's energy profile: In this step the country's energy profile is presented. Basic macroeconomic indicators are depicted in order to illustrate each country's macroeconomic status. Furthermore, a brief, yet thorough, analysis of the energy sector in Serbia and BiH as well as basic energy indicators for each country are presented. The energy sector analysis describes the main characteristics for each case study country in terms of energy production, consumption, transmission and distribution systems.

Step 2: Examination of RES potential: After the analysis of each country's energy profile, their RES potential is investigated. Tables are presented with each country's RES potential, while detailed analysis takes place.

Step 3: Investigation of RES political institutional framework: The investigation of the RES political and institutional framework constitutes the third step of this particular methodology. Within this step the existence, or not, of energy strategies, specific targets and guidelines as well as regional policy frameworks towards RES support is examined. Potential or actual barriers towards RES exploitation and development, for both countries, are addressed and analyzed in a comparative way. This step, in combination with steps one, and two will assist towards drawing conclusions regarding the country's capability for RES target achievement, RES exploitation and integrated promotion, while evaluating impacts and implications.

Step 4: Main outcomes: Finally, the fourth and final step presents the main outcomes derived from the comparative approach followed for Serbia and BiH.

3. Comparative analysis

3.1. Countries' energy profile

The energy profiles of BiH and Serbia are stated through a concise description of each country's basic macroeconomic indicators, as well as an energy sector analysis.

BiH: The institutional governance structure in Bosnia and Herzegovina was established within the General Framework Agreement for Peace in Bosnia and Herzegovina (1995), which ended war in Bosnia. Estimations put Bosnia's GDP figures at 12,249 million € (Table 1), while the GDP per capita, in 2010, was 3187.58 € [17]. The EU 27+ average values have been added in Table 1 for comparison reasons.

Examining the energy sector in Bosnia and Herzegovina, it can be remarked that it is characterized by high energy intensity in comparison with developed EU countries, which is the key indicator of the effects of energy utilization. In 2005, Bosnia and

Table 1
Summary of energy & economic data.
Source: [17–22].

	Indicator	BiH	Serbia	EU 27+ (mean values)
Main Macroeconomic Indicators (2010)	**GDP/capita**	3187.58 €*	4093.4 €*	24,400 €
	GDP	12,249 (mil. €)*	29,967 (mil. €)*	459,459 (mil. €)
	Inflation	1.9%	4.9%	1.1%
	Exchange rate	0.72 € per USD	1.3313 € per USD	1.3948
	Population (thousands)	3843,126	7306,677	18,565,179
Energy Sector Data (ktoe), (2007)	**Production**	3,938	9,751	31,736
	Import	2,441	7,258	54,351
	Export	−794	−1,212	17,805
	Reserves change	17	57	N/A
	Total consumption	5,602	15,854	43,164
Transmission & Distribution Systems Status		• Significant disasters during the war. • Imperative need for reconstruction.	• Increased electricity distribution and transmission losses. • Need to restore a reliable energy supply due to war damages	N/A N/A

N/A: not available.

* Estimations according to 2009.

Herzegovina's primary energy intensity (gross total primary energy supply per unit of GDP) was 0.938 toe/USD 2000, which is 2.5 times more than the primary energy intensity in the EU 27 countries and more than in almost all countries in the region [23]. According to Table 1, the total primary energy supply in 2007 was 5.6 Mtoe. Coal possessed the highest share in the total energy consumption (62.6%), while oil and its products (22.7%), natural gas (6.2%) and RES (9.4%) follow [20].

About 70% of coal energy production is destined for electricity generation and the rest for the industry and household sectors. The total balanced coal reserves in BiH are estimated at 5464 million metric tonnes. The major constituents are brown coal, with estimated reserves of 1886 million tonnes, and lignite with reserves of 3578 million tonnes [24]. The attained level of 40% of pre-war coal production satisfies the needs of all consumers [25]. The total natural gas needed for BiH is imported. The market of oil and oil derivatives has been fully open, while this sector is characterized by substantial production capacities. There was a privatization process of generation capacities carried out in the past in the facilities of Refinery of Brod and Modrica. The generation process began in those facilities and at the same time there was reconstruction of facilities in order to fully use all capacities. In particular, in the first six months of 2009, the achieved treatment of the Oil refinery Brod amounted to 543,800 tones, a level of utilization nearly 82%. Furthermore, it has to be noted that the net electricity export reached a share of 9% of the total primary consumption. Despite having about the same generation capacity as it did almost 20 years ago and having lost substantial infrastructure in the war, BiH remains one of the few countries in the region that is a net exporter of electricity. Exports in 2007 reached 794 ktoe, while a recent report anticipated that BiH would continue to be a viable exporter of electricity given an excess of installed capacity (3850 MW) over peak demand (1950 MW) [26].

Serbia: Serbia is a middle-income country with a great potential for fast economic development, as the country is endowed with natural and mineral resources and fertile and arable agricultural land. Serbia's GDP fell dramatically in the 1990s. However, since 2000 the GDP has increased steadily and in 2006 it was nearly 30% higher than in 2000. Strong economic progress has been achieved since 2001, particularly in expanding private sector participation in the economy. Macroeconomic stability, achieved swiftly in the first years of transition, has been broadly maintained although economy is currently hit by global downturn. Serbia has a total dependence of 40%, and compared to the energy dependence of other EU 27+ countries [27] the country's energy dependence is considered average.

The energy sector is a major polluter in Serbia, mainly due to the use of domestic lignite, which is burned using old equipment without abatement technology. Indeed in Serbia energy utilization is inefficient. In fact it uses five times the amount of energy to produce one unit of GDP compared to the EU average [28]. Serbia's carbon intensity per GDP is 6.8 times the world's average and 10.8 times the average of the Organisation for Economic Co-operation and Development (OECD) [29]. Transmission and distribution losses were 2.79% and 14%, respectively, in 2008 [30,31].

In 2007 the country's total primary energy supply was 15.8 Mtoe (Table 1). Coal played the most significant role in this amount, having a share of 49.8%, while oil and its products (27%), natural gas (12.4%) and RES (10.8%) follow. The primary energy supply's import dependence was 38.6%, share which is slightly decreased if compared to 2005 (41%) [32].

The current hydroelectric power capacity is 10,200 GW h/yr, while potential capacity is estimated at 14,200 GW h/yr.

The energy production sector suffered from a variety of problems prior to the reform period, including under pricing of services, lack of adequate maintenance and investment expenditures, lack of competition, excessive employment and a resulting large fiscal drain on government resources [33].

As it can be observed, regarding the transmission and distribution systems (Table 1), both countries suffer from transmission and distribution losses, either due to disasters caused by war, or due to the system's obsoleteness. Therefore, the main objective for BiH and Serbia is the need for reconstruction of the transmission and distribution system.

3.2. Examination of RES potential

This step investigates the RES potential of BiH and Serbia in order to further explore their energy sector and to highlight the RES sectors that need to be further developed.

BiH: Currently only hydropower contributes to BiH's energy consumption. However, the country has significant potential of renewable resources in terms of additional small hydro, wind, solar and biomass (Table 2) [2].

Wind: As regards wind energy, a preliminary study estimated an economic wind potential at approximately 600 MW. As shown, in Fig. 1 the wind potential is greatest in the western portion of the country where the velocities can reach up to 9 m/s [34]. Furthermore, wind potential of BiH has a 30% higher utility coefficient than the EU average and the highest potential in the Balkan Region.

Solar: The solar energy potential in BiH is also significant (Fig. 2). Annual solar irradiation is estimated at 1240 kW h/m^2 in the north of the country and up to 1600 kW h/m^2 in the south. BiH has on average 1840.9 h of sun annually, while in the south, this number reaches 2352.5 h annually. The theoretical potential for BiH is estimated at around 74.65 PW h, while the technical potential is about 1903 TW h, both of which are substantially more than the energy needs of the country [36].

Hydro: Depending on hydrological conditions, up to 45% (estimated 6000 GW h in 2010 [38]) of total generation may come from hydro plants with installed hydro capacity close to 57% (2000 MW) of total installed capacity. Furthermore, an Energy Sector Study [37] identified that around 300 MW of planned small hydro could account for a total future potential of approximately 1000 MW.

Biomass: Energy produced on the basis of burning wood and wood products has huge potential in BiH due to large forest and quite developed wood processing industry. First project in this field is currently underway in eastern part of BiH in Srebrenica and financed by UNDP [32].

Geothermal: Geothermal sources have been poorly investigated in the country and studies report that the identified potential could mainly be utilized for heat production. According to a study by EIHP, the total potential capacity of geothermal sources for space heating is nearly 9.25 MW t spread to 42 locations able to produce approximately 40.5 GW h of energy per year [2]. At present, there are no geothermal power plants in Bosnia and Herzegovina.

Serbia: The country has extensive unused potential for greater energy efficiency and RES production. Serbia's renewable energy potential can cover almost half of its primary energy needs. Moreover, projections suggest that with minor adjustments in the regulatory system, RES could easily rise to one-third of Serbia's overall primary energy consumption, which now relies on fossil fuels for 93% of its supply [39].

Wind: The wind energy potential is about 1.9 Mtoe a year (2.3 TW h/yr). This potential is based on the long-term data of the existent hydro-meteorological stations that carry out measuring on 10 m altitude and on the new data where measuring was carried out on 100 m altitude, Fig. 3 [17,19,40].

Solar: According to the available data, use of photovoltaic solar energy is currently almost negligible. Solar energy is used for water and space heating in the domestic and tourist sectors, but there are no figures on the extent of this use. The country's solar energy exploitation potential is approximately 0.64 Mtoe a year.

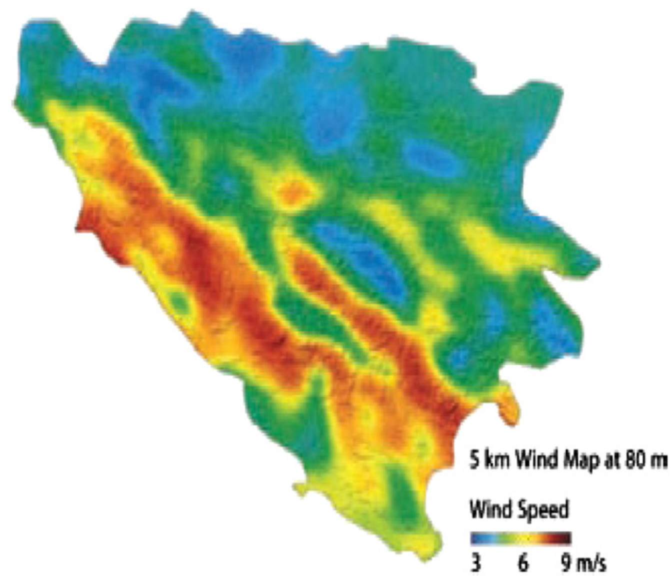


Fig. 1. Wind map of BiH.
Source: [34].

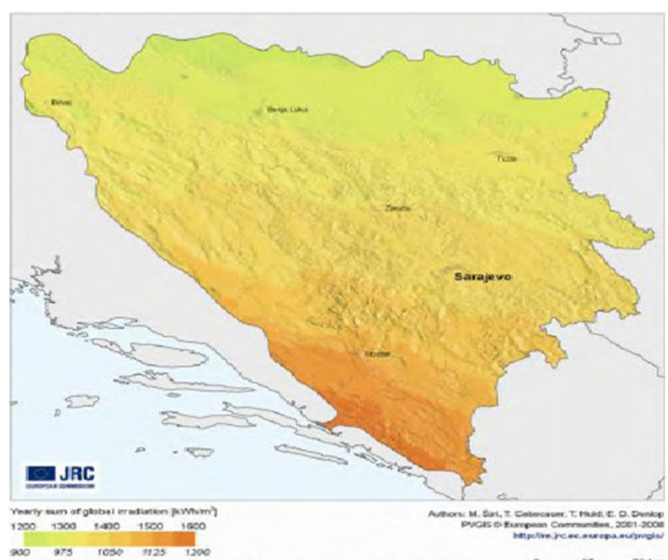


Fig. 2. Irradiation and solar electricity potential in BiH.
Source: [35].

Table 2
RES potential.
Source: [2,38].

	BiH	Serbia
Wind	2000 MW (600 MW economically feasible)	2.3 TW h/yr
Solar	1240–1600 kW h/m^2/yr	0.64 Mtoe/yr, 1400 kW h/m^2/yr
Hydropower	13 TW h/year of which 2.5 TW h/year small HPPs	0.9 Mtoe small hydro: 0.4 Mtoe/1500 GW h/yr
Biomass	~14 PJ (3.9 TW h) wood waste: 2000,000 m^3/yr— 5200 GW h/yr	2.7 Mtoe/yr (31.4 TW h/yr)
Landfill gas		188 GW h/yr
Biogas		42.2 ktoe
Geothermal	40.5 GW h	2.2 TW h/yr (0.2 Mtoe/yr)
Hydrothermal		2415 TJ/yr (671 GW h/yr)

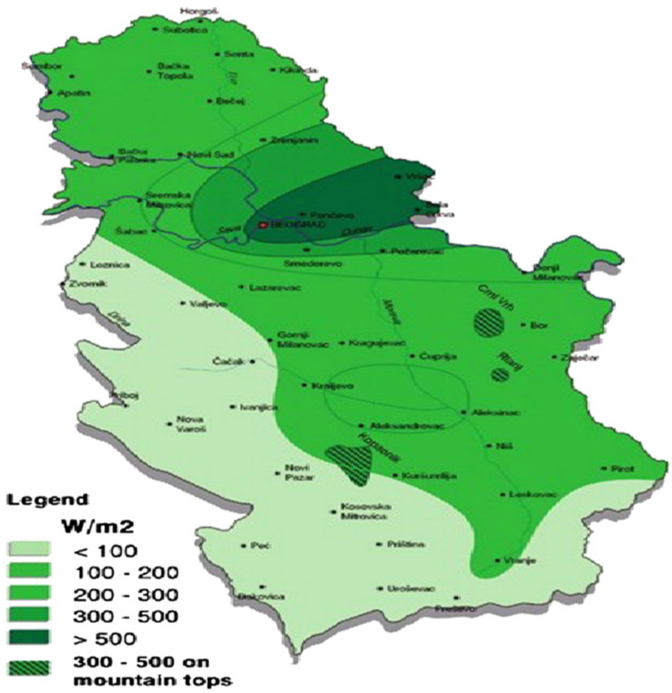


Fig. 3. Average wind power in Serbia. (Height: 100 m).
Source: [40].

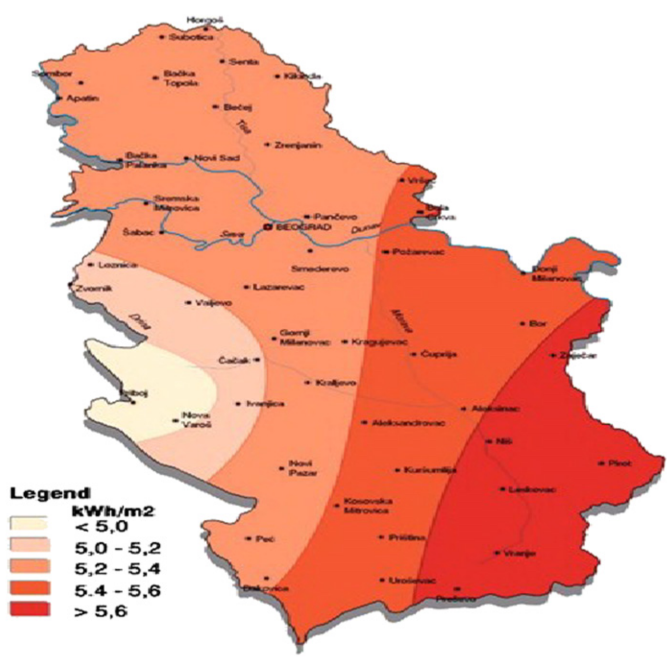


Fig. 4. Daily average of solar energy on horizontal plane in Serbia.
Source: [40].

In Serbia the solar energy potential is vast (Fig. 4), as the number of solar irradiation hours is much higher than in some other European countries reaching approximately 2000 h/yr [13].

Hydro: The unused hydropower potential (0.9 Mtoe) in Serbia is situated mainly in the catchments of Drina and Morava rivers and it can be utilized for large as well as for small HPPs. According to the electricity utility company Elektroprivreda Srbije, this potential may be used in 52 large HPPs that would have average capacity of around 25 MW [1]. Around 0.4 Mtoe a year are found in small streams, where the smaller hydro-electric power stations could be built. This estimation is based on the land register of small hydro-electric power stations where there are 856 locations suitable for building small power stations of 90 kW to 8.5 MW, of the total power of 450 MW and 1590 GW by which around 90% of locations have the technical potential under 1 MW [33].

Biomass: With 55% of its territory being arable land, and 25% under forests, Serbia has high biomass potential. This potential lays around 2.7 Mtoe annually, (63% share in the total RES potential), where 1.1 Mtoe represents the wood biomass potential (woodcutting and wood mass refuse produced in its primary and/or industrial processing) and more than 1.6 Mtoe constitute agricultural biomass (agricultural and farming cultivation residues, including also liquid manure) [1,10–12]. Production of pellets is also considered as very promising, having a potential of 250–350 kt/yr from sawmill waste [32].

Landfill Gas: On average, 200 N m^3 of landfill gas is formed per ton of communal waste for about 20 years. For a total yearly amount of 2.2 million tons (the whole Serbia) within the period of 20 years, about 8.8 billion m^3 of landfill gas would form. If only about 10% of this gas was collected, 880 million N m^3 of landfill gas would be available, i.e., an average yearly amount of 44 million N m^3, i.e., 5500 N m^3/h.

Biogas: Though 9 biogas facilities were constructed on large pig and cow farms in Serbia, (7 in Vojvodina region), during the 1980s, none of them is now operational. The Energy Development Strategy estimates that, by 2015, about 7% of the evaluated 3,183,000 N m^3/yr could be exploited for electricity generation. The first stage of such a program would be the rehabilitation of the six large-scale biogas operations at 6 existing farms [33]. Energy potential from agricultural wastes is also suitable for biogas production and is estimated about 42.2 ktoe/yr [41].

Geothermal: Considerable potential for geothermal energy installation exists in Serbia. This potential may be used for residential, institutional and industrial applications, which could replace the use of at least 500,000 t of imported fuels annually [42].

Hydrothermal: The geothermal potential, is estimated at almost 2.2 TW h (0.2 Mtoe/yr) and is mainly located on the territory of Vojvodina [31]. Approximately 160 locations have been investigated and some 50 of them have potential over 1 MW t h [30].

3.3. Investigation of RES political and institutional framework

Within the third step elements such as the institutional instruments of BiH and Sebia, the existence, or not, of energy strategies, specific targets and guidelines, regional policy frameworks towards RES support, as well as, present or future barriers towards RES exploitation and development, are assessed in a comparative way. At this point it has to be mentioned that as regards the institutional instruments regarding energy (Table 3), the data presented are the result of extensive scientific research and local experts' interviews and discussions, within the framework of the ''Study on the Implementation of the New EU Renewable Energy Directive in the Energy Community'', funded by the Energy Community Secretariat (ECS) [43].

BiH: At the State level, an Institute for Renewable Energy and Energy Efficiency is needed to provide skilled experts and analyses in support of the ministries' work. As depicted in Table 4 the energy sector coordination is the responsibility of the Ministry of Foreign Trade and Economic Relations (MOFTER), which also, has an organizational chart that envisions expanding the Energy Department [23,44].

In the Republika Srpska, renewable energy incentives and combined heat and power are regulated by the Regulatory Commission for Energy of the Republika Srpska [23]. In the Federation of BiH (FBiH), the Regulatory Commission is still

Table 3
Institutional instruments regarding energy.

Responsibilities	BiH	Serbia
Energy sector coordination and designation of the energy policy	• Ministry of Foreign Trade and Economic Relations (MoFTER) • Ministry of Energy Mining and Industry of FBiH (MEMI) • Ministry of Economy, Energy and Development of the Republika Srpska (MEED)	• Ministry of Mining and Energy (MoME)
Responsibilities regarding the environmental protection and climate change activities	• Ministry of Physical Planning, Civil engineering and Ecology of Republic Srpska, acting as a Focal Point of Bosnia and Herzegovina to the UNFCCC and the GEF Operational Focal Point BiH for climate change issues • The State Steering Climate Change Committee • GEF Political and Operational Focal Point within the Ministry of Foreign Trade and Economic Relations • Administrative Committee for the Environment and Sustainable development of BiH and its SubCommittee for climate change	• Ministry of Environment and Spatial Planning
Energy efficiency – RES use increase	• Center for Energy Efficiency (CEEF) • Center for Education and Raising Awareness of Energy Efficiency (ENERGIS)	• Serbian Energy Efficiency Agency (SEEA) • Regional Centers for Energy Efficiency
Energy conservation project's financing – RES promotion	• Republika Srpska & FBiH Funds for Environmental Protection	• National Energy Efficiency Fund (U/D)
Regulation of the secondary energy sector, feed-in-tariffs, licensing	• State Electricity Regulatory Commission (SERC) • Federal Electricity Regulatory Commission of Bosnia and Herzegovina (FERC) • Regulatory Commission for Electricity of the Republika Srpska (RERS) • Independent System Operator (ISO) • Transmission Company of Bosnia and Herzegovina	• Serbian Energy Agency (EARS)
Technical supervision of energy companies	• N/A	• N/A
Consultation related to energy issues	• N/A	• N/A

N/A: Not Available.

Table 4
Assessment of regional policy frameworks to support RES.
Source: [2].

	BiH	Serbia
RES strategy	+*	++
Primary legislation	+*	+
Secondary legislation	+*	+
Licensing	–	–
Support mechanisms	+*	+
Tariffs	+*	+
Duties and taxes	+*	–
National targets on RES	–	+*
Guarantee of origin	–	–
Grid access	+*	++
Donor/foreign investor actions	++	++

++: fully implemented, +: partially implemented, +*: planned but not implemented, –: nothing.

creating the legal framework and conditions for electricity supply and connections. There is no policy or strategy regarding renewable energy sources in Bosnia and Herzegovina so far (Table 4), except for the provisions incorporated in the National Environmental Action Plan (NEAP) and the Mid-term Development Strategy (PRSP) [45]. Targets to be achieved for renewable energy sources have to be met indirectly through international obligations, such as the Energy Community Treaty, the Energy Charter Treaty and applicable EC Directives [30]. On the other hand, a regulation on the utilization of RES and cogeneration was adopted not earlier than 2010 [45].

However, a study on the energy sector in Bosnia and Herzegovina, which should provide a basis for the strategy, was finalized in May 2008 [31]. In 2008, the country worked on a first draft of a RES Strategy. However, neither the Federation of Bosnia and Herzegovina nor the Republic of Srpska have yet developed a RES Strategy.

The central support mechanism existing to date is based on two laws at the entity level that set the minimum electricity purchase price to be paid to RES producers with an installed capacity up to 5 MW in small hydro power plants, biomass, wind, geothermal, solar PV [2].

In May 2009, the National Assembly adopted "Law on Energy". This document determines the basis of the energy policy of the Republika Srpska, the construction of the energy development strategy, basic issues of regulation and realization of energy activities, usage of RES and conditions for achievement of energy efficiency (Chapters V and VI (Articles 27–34)). It was prescribed that the energy development strategy was to be made by the National Assembly of the Republika Srpska at proposal of the Republika Srpska Government, while the Government would make the action plans for implementation of the Strategy.

In addition, BiH ratified Kyoto protocol in April 2008. (A Decree on ratification of the KP published in the BiH Official Gazette 3/08) [46].

The lack of secondary legislation, coupled with weak and very restricted support mechanisms, are the predominant barriers hindering RES deployment. The country has substantial RES

Table 5
Goals & barriers towards RES exploitation & development.
Source: [47,48].

	Goals	Barriers
BiH	N/A	Inefficient legislative framework Lack of specific goals Complex administrative procedures
Serbia	2.2% increase in the share of electric energy produced from RES, compared to the overall consumption level in 2007, until 2012	Incomplete regulatory framework
	2.2% share of biofuels and other renewable fuels on the market, until 2012	Complex administrative procedures Inefficient co-operation between entities

N/A: not available.

potential, but there are very few projects being implemented, which indicate the need for the Government to design an appropriate package of financial incentives (economic and fiscal) to promote renewable energy investment [2].

It becomes obvious from Table 5 that BiH has not set any targets regarding RES promotion and energy efficiency [47,48]. The establishment of credible RES promotion and energy efficiency targets is difficult due to structural change's scale in the economy, the relatively depressed state of industry, and the reliability of baseline statistics [34].

As observed in Table 5, obstacles towards RES projects development are of political, regulatory and administrative nature. Barriers of political nature arise from the fact that RES strategy, which would set guidelines for RES development, is not yet adopted, while the same stands for RES targets. Although entity electricity laws in principle promote the use of RES for electricity production, the implementation regulations on supplied electricity from RES and on acquiring eligible electricity producer status, are still not in place. Complex administrative procedures include obtaining of relevant concessions and licenses for construction of generating capacities, other than those for own use.

The country has substantial RES resource potential, though there are very few projects being implemented, parameter that indicates the need for the Government to design an appropriate package of financial incentives (economic and fiscal) to promote renewable energy investment [20].

Current situation in BiH is that Funds for environmental protection were established in the FBiH and the the Republika Srpska on the level of entities, with the main objective of implementing energy efficiency measures and encouraging the use of renewable energy sources, primarily for the purpose of protecting the environment [32].

Serbia: At a political level, the energy sector is a responsibility of the Ministry of Mining and Energy (Table 3). The Serbian Transmission System Company ''Elektromreza Srbije'' (EMS) acts also as the Electricity Market Operator. The Serbian Energy Agency, established by the Energy Law in 2004, is a regulatory body responsible for the determination of the market rules, issuing of licenses etc [2].

In order to systematically resolve the energy demand issue and to synchronize development with the requirements of ratified international contracts, Serbia adopted a series of basic developmental documents that indicate the necessity of the sustainable management of energy resources [49].

In line with the Energy Law and the Strategy, the MoME prepared the Energy Strategy Implementation Programme—ESIP 2007–2012, which was adopted by the government in January 2007 and establishes the RES framework in the country. This Program defines conditions, methods and time schedule for the implementation of the Strategy in all the major parts of the energy sector.

However, the secondary legislation necessary for the operation of the Privileged Producers was enacted only recently. This consists of the Decree of Conditions for Acquiring Status of Privileged Producers and Criteria for Granting Status (adopted in September 2009); and the Decree on Feed-in tariffs for the RES-E generation (adopted in November 2009) [33]. This secondary legislation defines the terms of relations between the privileged alternative source producer and electrical grid operators that will buy the electricity and ultimately sell it to the final consumers. The legislation provides incentives for the development of renewable electricity generation [50,51]. However, there is no legal framework for ESCOs and the public procurement law does not recognize them.

Finally, Serbia has ratified the Kyoto Protocol as non-Annex 1 Country since 2007. The law entered into force on 17th January 2008, meaning that Serbia will be eligible for CDM projects.

In this respect, the objective of the Republic of Serbia before the end of 2012 is to enhance its power generation from renewable energy sources by 7.4 per cent or 735 million kilowatt hours compared to 2007 and to increase consumption of RES-E for 2.2% until 2012. Moreover it aims at reaching at least a 2.2% market share of biofuel and other renewable fuels consumption (based on energy content calculation) in the transport sector [47].

To realize the first objective by 2012, the construction of 102 MWe RES electricity generating capacities by attracting private project developers and funds is foreseen. Thereby market conditions for "green electricity" production increase of 739.1 GW h will be created.

During this period, electricity production from RES will increase at about 7.4%—from 9974 GW h in 2007 to 10713.1 GW h in 2012.

Furthermore, it is predicted that at least 45 MWe small hydro power plants, 45 MWe wind plants, 5 MWe solar photovoltaic plants, 2 MWe biomass fueled plants and 5 MWe biogas fueled plants will be constructed in the period up to 2012, with total investments ranging at around EUR 200 million.

On the other hand, in order to reach a 2.2% share of biofuels, in the transport sector, in 2012, a viable solution will be to introduce an obligatory mix of biodiesel into diesel fuels, by setting a minimum volume content of methyl ester of melissic acid (MEMK) into diesel fuels. This objective will be possible to meet if the total oil derivatives consumption, in the transport sector, reaches the planned 2009 level—586,332 t of motor gasoline and 1909,671 t of diesel fuels [52].

The current situation in Serbia is characterized by the establishment of the National Energy Efficiency Fund, which is comprised in the Strategy of the Serbian Economical Development, Energy Sector Development Strategy, and included in the Program for its implementation. The Fund will be used for promotion of wider use of RES and increase of energy efficiency, and should be established through amendments of the Energy Law or through some other legislation [32].

Key obstacles for RES deployment in Serbia are in the area of regulatory and administrative sector capacity (Table 5). The administrative procedures for authorization, licensing and network connections are the biggest barrier to the uptake of renewable energy, while the development of the Serbian regulatory system for renewable energy will require continuous monitoring to ensure compliance with the EU acquis. Furthermore, Serbia will need to reinforce its administrative capacity in order to ensure effective implementation and enforcement of its legal obligations in the energy sector. The effective independence of regulatory bodies will require particular attention [53].

3.4. Main remarks

In view of the above analysis a series of remarks derived from the comparative approach followed for Serbia and BiH may be drawn. Both countries face inner political uncertainties; it is, therefore, not surprising that they lag in developing a proper and concrete framework for full exploitation of their RES potential in their energy mix, as their economies are, straggling to upturn to a financially stable phase. Economic reforms to liberalize the economy in Serbia have been implemented, but political uncertainty limited their impact and although the economy of Serbia is strongly growing, progress in macroeconomic stabilization is mixed. On the other hand, Bosnia's economy is recovering, aided by improvements in external demand with a stronger bounce in growth expected in 2011.

Regarding the institutional framework, BiH encounters substantial issues. The country has not yet defined administrative responsibilities developed or approved legislation, while national goals for RES still lag behind. On the other hand, in Serbia administrative responsibilities are well defined, though the regulatory framework is still deficient [54]. In BiH the complex political and economic backdrop and the large number of institutional instruments regarding energy, face ongoing challenges. Furthermore, they consequent in composite procedures towards the creation of the enabling framework of laws institutions and measures across two entities and a District, while they further perplex by issues of alignment and symmetry of powers [34]. It should be mentioned that the regulator at the national level is currently weaker than the entity-level regulators. Respectively, in Serbia, an Energy Efficiency implementing Agency (SEEA) has already been formed and constitutes a regulatory body, i.e., legal entity with all the rights, liabilities and responsibilities stipulated by the Energy Law and other regulations. In addition, energy efficiency policy goals and a strategy exist, as well as related action plans supported by policy tools. Furthermore, the value of the energy intensity indicators is also remarkable, revealing that in both countries energy efficiency improvements are not yet set, while losses on electricity transmission and distribution grids are estimated fairly high.

Regarding the RES potential, in BiH studies reveal that it is significant and the development of small hydro power plants (up to 5 MW) seems to be the most promising renewable energy source at the moment, since BiH has substantial theoretical hydro power potential. Likewise, the Energy Sector Development Strategy by 2015 of Serbia [52] recognizes that the most considerable renewable energy source in Serbia is currently hydropower. Furthermore, the most significant source of biomass for energy production in BiH is wood from forestry (firewood, forestry residues) and wood waste from the wood processing industry, whereas it is also remarkable that BiH's total potential of solar energy is estimated at 67,200 TW h, value that many times exceeds the total energy consumption in the country [55]. In this context, the Energy Sector Development Strategy by 2015 of Serbia particularly emphasizes the importance of new RES utilization for decentralized heat production, through biomass combustion and capture of solar radiation, as well as for decentralized power production, through the construction of small hydropower plants with an installed capacity of up to 10 MW, in order to meet the needs of local consumers and deliver surplus power to the local network within the Serbian power system.

In contrast with the extended RES potential of these countries, a mix of several legal, institutional and administrative barriers, as well as economic and financial constraints and lack of awareness, human capacities and professional skills hinder the implementation of RES and energy efficiency measures, policies and projects in both countries. In Serbia, it has been noticed that authorization procedures for RES projects are complicated and cumbersome, while dedicated laws, supporting energy efficiency and RES are still under development. On the other hand, in BiH, the absence of decisional competences in energy matters at the state level hampers and slows down any progress in the policy development at national level [56]. The lack of interaction and coordination between the Bosnian entities leads to the absence of a harmonized plan for investments at the national level. In addition, the electricity generation costs are still very low, especially taking into consideration that they do not include environmental components (costs for CO_2-emission abatements, costs for carbon, etc.). Therefore, no incentive towards withdrawal of hydrocarbon sources of energy in BiH exists [57]. In Serbia, respectively, the absence of public funding dedicated to energy efficiency and RES projects, constitutes a strong barrier, while the absence of financial incentives in place for energy efficiency is evident. In addition, it is worth mentioning that lack of awareness and capacities to successfully develop energy efficiency and RES projects, may be ascertained by all administrative levels in BiH, while additionally energy customers and commercial financial institutions do not have the required skills for energy efficiency implementation. Likewise, lack of qualified human resources appears to be a major barrier throughout the entire public administration in Serbia, whereas technical skills seem to be available mainly in the private sector.

4. Conclusions

The use of RES nowadays is a reasonable and technically mature option towards the emerging and stressing energy and climate change problems. This paper presents a comparative study between BiH and Serbia regarding the RES progress in economic, political and institutional view.

The analysis of BiH's energy sector resulted mainly in the following aspects:

- The energy sector is characterized by high energy intensity in comparison with developed EU countries, which is the key indicator of the effects of energy utilization.
- The energy production derives mainly from coal, which possesses the highest share in the total energy consumption.
- The total natural gas needed for BiH is imported.
- BiH remains one of the few countries in the region that is a net exporter of electricity.
- Regarding the regional policy framework to support RES BiH:
- Has not developed any comprehensive energy strategy, except for the provisions incorporated in the NEAP and the PRSP and some laws passed at entity level.
- The regulatory environment fails to meet an adequate level. Until 2011 BiH has not set any targets regarding RES and energy efficiency promotion.

The development seems to be a slow process, at least the process is now in place and its institutional framework is partly established, though further strengthening is required. The Energy

Strategy is now in place, exhibiting the country's awareness as regards the RES importance and the existence of a correct energy strategy plan, the implementation procedures are quite cumbersome and therefore, delayed and several obstacles of political, regulatory and administrative nature towards RES projects development are faced in the region. Notwithstanding the barriers encountered, the country has substantial RES resource potential, however there are very few projects being realized, parameter that indicates the need for the Government to design an appropriate package of financial incentives (economic and fiscal) for the promotion of RES investment. Currently only hydropower contributes to BiH's energy consumption. However, the country has significant potential of renewable resources in terms of additional small hydro, wind, solar and biomass.

On the other hand, Serbia's economic progress has been substantial during the past years, but economic reform and restructuring are continuous challenges. The country is endowed with natural and mineral resources, however the full exploitation of the domestic lignite, which is burned using old equipment without abatement technology, has affected Serbia's energy sector:

- The energy sector is a major polluter and the energy produced is not used efficiently and energy intensity is very high.
- The energy production sector suffered from a variety of problems prior to the reform period.

In order to resolve systematically the energy demand issue and to synchronize the development according to the requirements of ratified international contracts, Serbia adopted a series of basic developmental documents that indicate the necessity of the sustainable management of energy resources. In this respect, the objective of the Republic of Serbia before the end of 2012 is to:

- enhance its power generation from RES,
- increase consumption of RES-E until 2012, and
- reach at least a 2.2% market share of biofuel and other renewable fuels consumption (based on energy content calculation) in the transport sector.

The institutional framework of Serbia is efficiently established, as well as a RES utilization policy, with specific goals and targets, though better coordination among the different entities would further boost the RES implementation. Other key obstacles for RES deployment in Serbia appear in the area of regulatory capacity. The lack of an effective regulatory environment makes it hard to implement existing laws and largely blocks entrepreneurs from implementing their own projects. While several laws are in place, often no sub laws or regulations exist, on how to implement these laws and Serbian legislation also does not create incentives to encourage RES production. In conclusion, the country has extensive unused potential for greater energy efficiency and RES production. Serbia's RES potential can cover almost half of its primary energy needs and projections suggest that with minor adjustments in the regulatory system, RES could easily rise to one-third of Serbia's overall primary energy consumption.

In retrospect, BiH and Serbia have already introduced RES into their energy mix in shares ranging from 3% to 17% of their total primary energy supply, despite the existent institutional, legal and bureaucratic difficulties. Their potential is really high, as RES like solar, wind and biomass, if exploited and utilized effectively, it is possible to cover almost a great percentage of the primary energy needs and to achieve the Directive's targets. Even though various obstacles exist towards this end, like deficient or inexistent legislative, regulatory or institutional framework, obsolete or destroyed distribution systems and equipment, post war economic recession, both countries are striving to solve these barriers through the development of energy and environmental strategies and action plans, through the establishment of the essential and relevant institutional framework, so as to support the initiative towards further exploitation of RES in the countries, and through the adoption of energy efficiency measures.

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